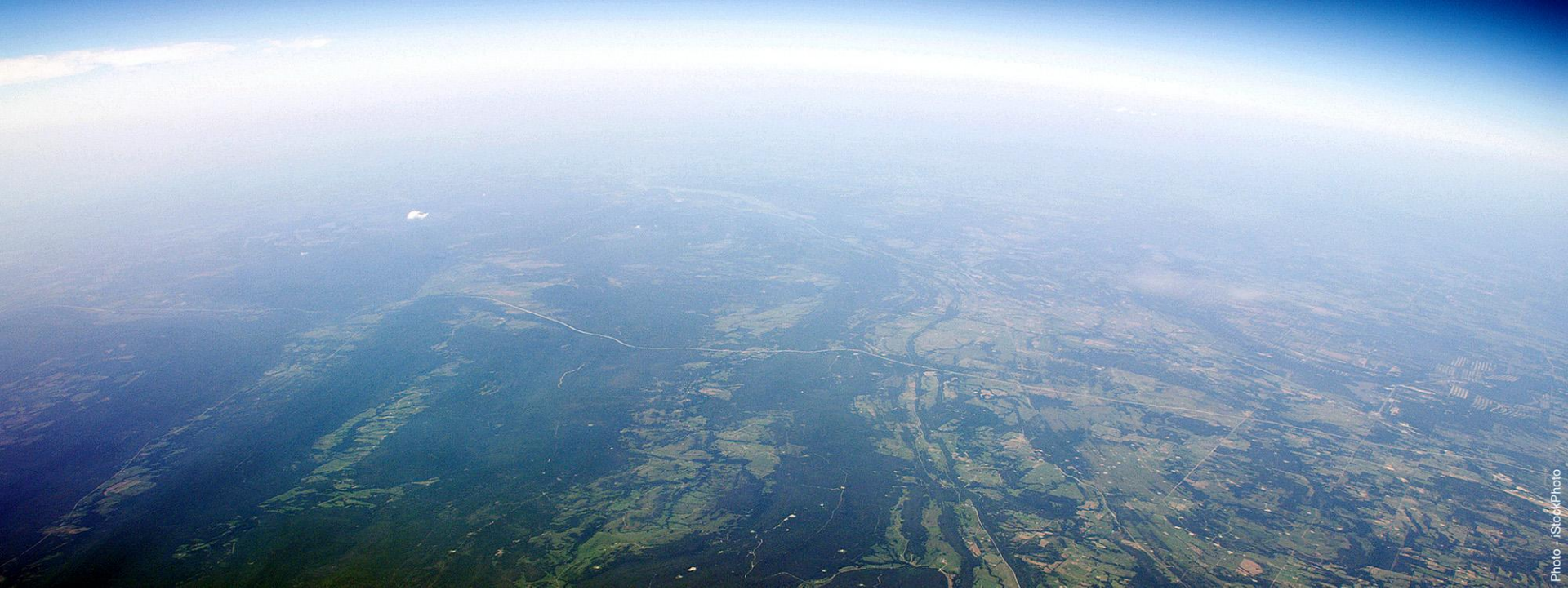

COSMOS-UK: Sampling strategy

Ross Morrison, James Blake, Helen Ward, Jonathan Evans , Ned Hewitt, Lucy Ball, Matt Fry, Daniel Rylett, Luisa Doughty & David Boorman

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Introduction

- **New UK Soil Moisture Real-time Monitoring Network: COSMOS-UK**
- Built and operated by: The Centre for Ecology & Hydrology, funded by NERC
- To provide UK wide field-scale soil moisture measurements
- New data to transform hydro-meteorological sciences and related environmental fields

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Science Exploitation

Potential uses of the data may include

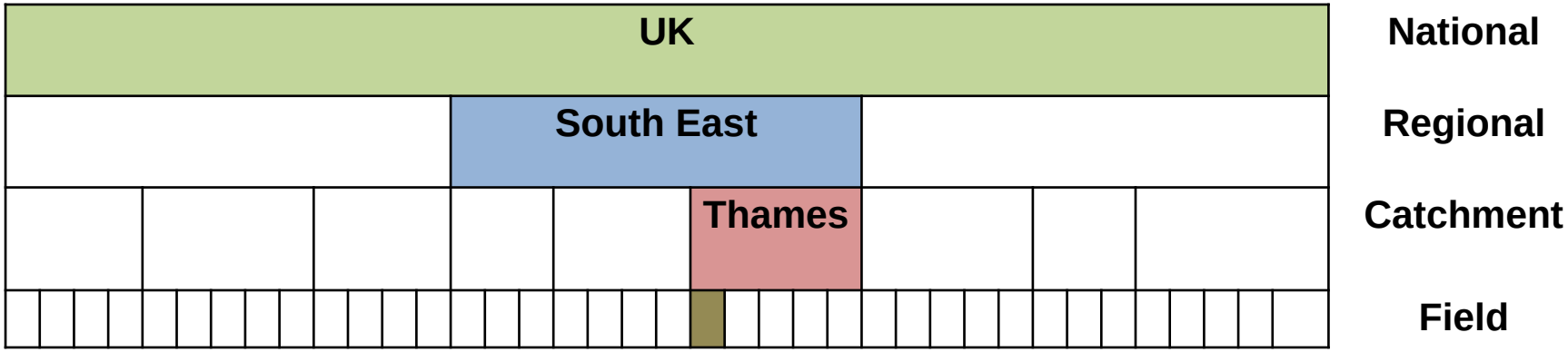
- Input to land-atmosphere models
- Process understanding
- Weather prediction
- Climate studies
- Evaluation of model output
- Comparison with satellite data
- Hydrological modelling
- Prediction of crop yield
- Irrigation scheduling
- Groundwater recharge
- Ecological studies
- Greenhouse gas controls

COSMOS-UK network objective

- Provide UK-wide monitoring of soil moisture and meteorological variables for next 5 to10+ years
- Distribution of 30 to 40+ sites across the UK by autumn 2014
- No sites currently planned in Northern Ireland - may be addressed in a future phase
- Pragmatic approach to site selection

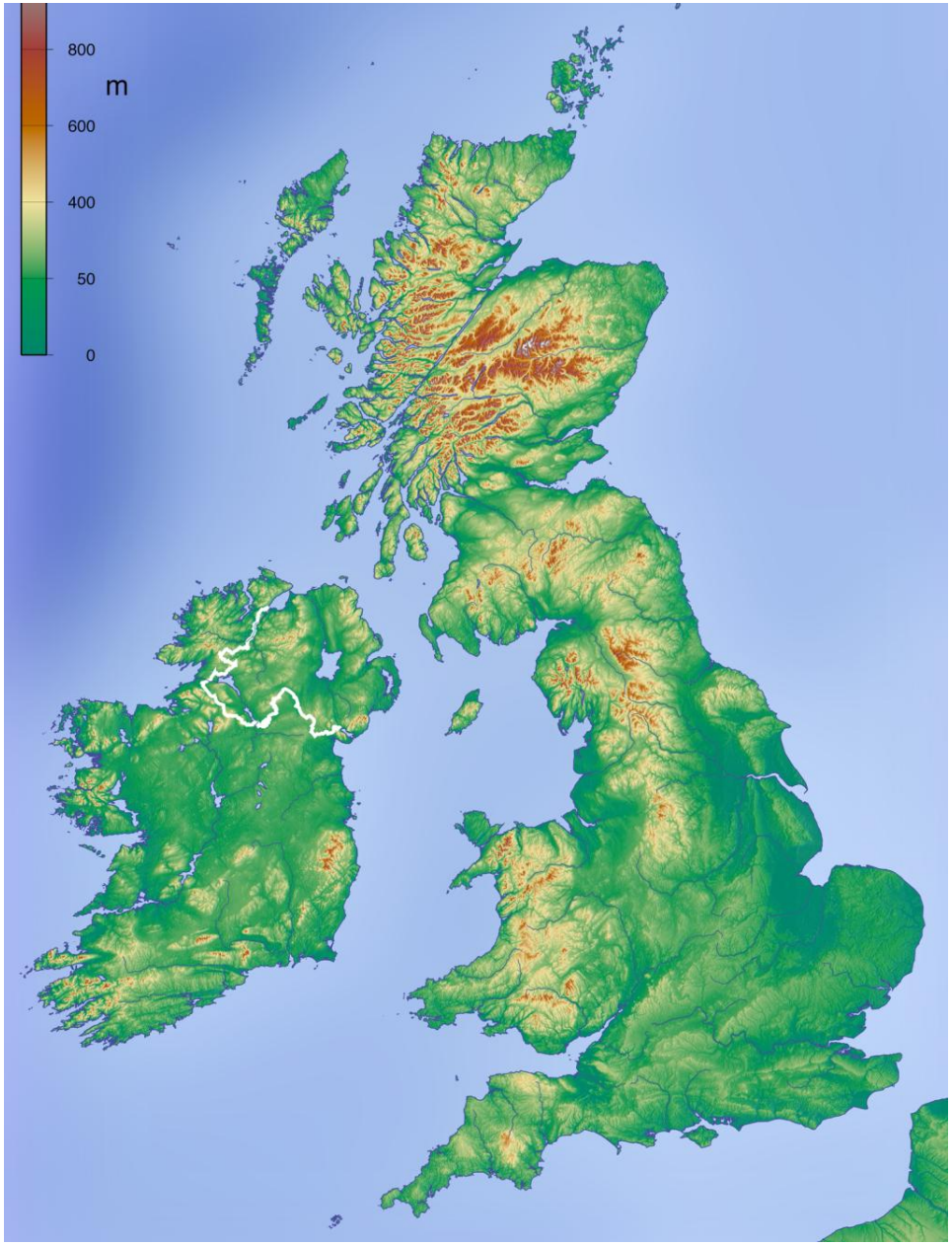
Sampling Strategy - Ideas

- Where to locate ~30 to 40 sensors?
- UK wide coverage
- Evenly distributed?
- Clusters (e.g. largest expected range, likely drought/flood susceptibility, well-studied catchments)?
- Nested scales – spatial variability?



UK Environmental Variables

- Factors
  - climate
  - soil
  - geology
  - land cover
  - topography
- Complications
  - snow & woodland
  - varying biomass



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COSMOS-UK Site Selection

Science exploitation example

- CEH scientists asked to suggest existing field sites and/or ideas for future sites
- No guarantee of site selection
- Every suggestion looked at in detail

☐ Existing Field Site ☐ Suggested Future Site Idea

COSMOS-UK: Soil Moisture Observing System Network

CEH Science Exploitation Group - Site Selection

Please complete as many boxes as you can/wish!

Site name	
Location (nearest village/town & county, OS grid ref or lat/long)	
Land owner (e.g. Forestry Commission, National Trust, Crown Estate etc)	
Current purpose of site (e.g. crop studies)?	
Details of ongoing long-term environmental monitoring/modelling?	
Land cover type (e.g. grassland, cereal crops etc)?	
Soil type?	
Reasonably flat site?	
Current access agreement (goodwill/paid short/long-term etc)?	
Potential permission for soil sampling?	
Is the site protected? (SSSI etc)	
Vehicular access possible?	
Security / vandalism issues?	
Significant topographic shading?	
Any streams, rivers, water bodies etc within 350 m?	
Shallow/perched groundwater present?	
Your name	
Your e-mail / phone no.	

We do not need site owner/manager details at this stage as we do not intend to contact them without first consulting you

Please return completed forms to James Blake, CEH Wallingford (jarib@ceh.ac.uk) by 5th June. Thank you!

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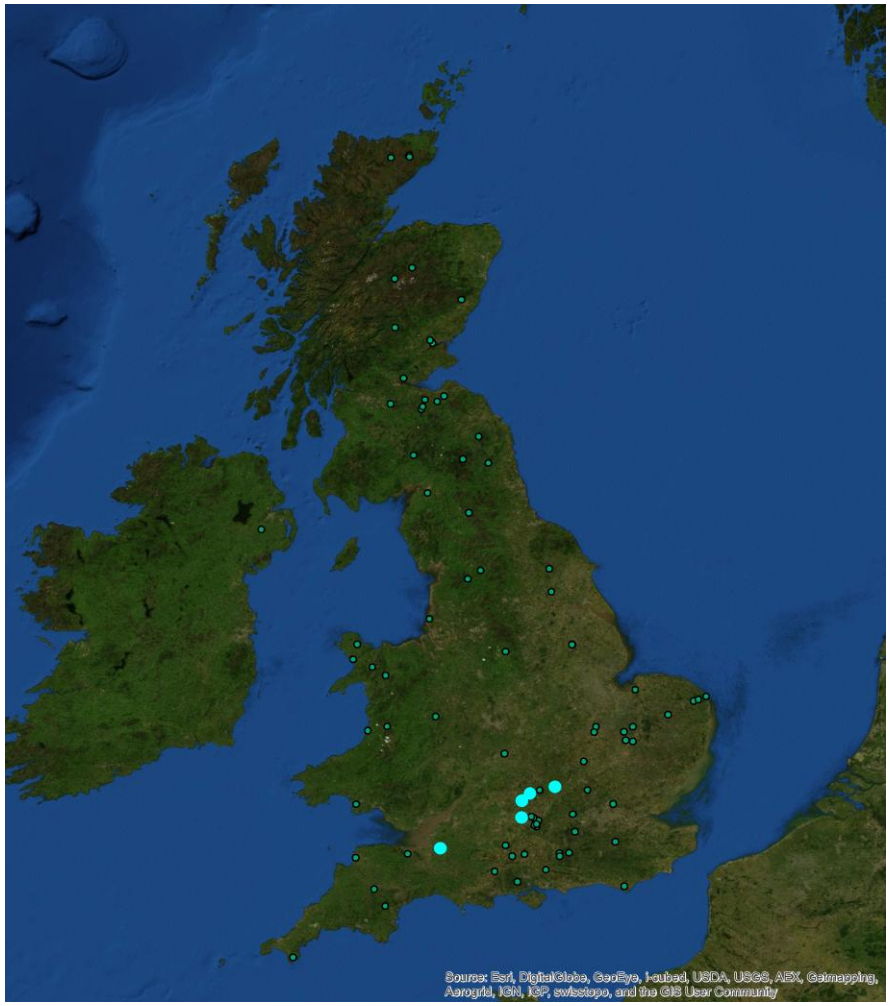
COSMOS-UK Phase 1 Prototype Sites

- Initial focus on existing CEH field sites
- Close to CEH Wallingford
- Finalise system design and test data acquisition, telemetry and data management systems
- Selection weighted towards areas with large soil moisture variability
- Three grasslands, one ancient deciduous forest, and one wet grassland pending



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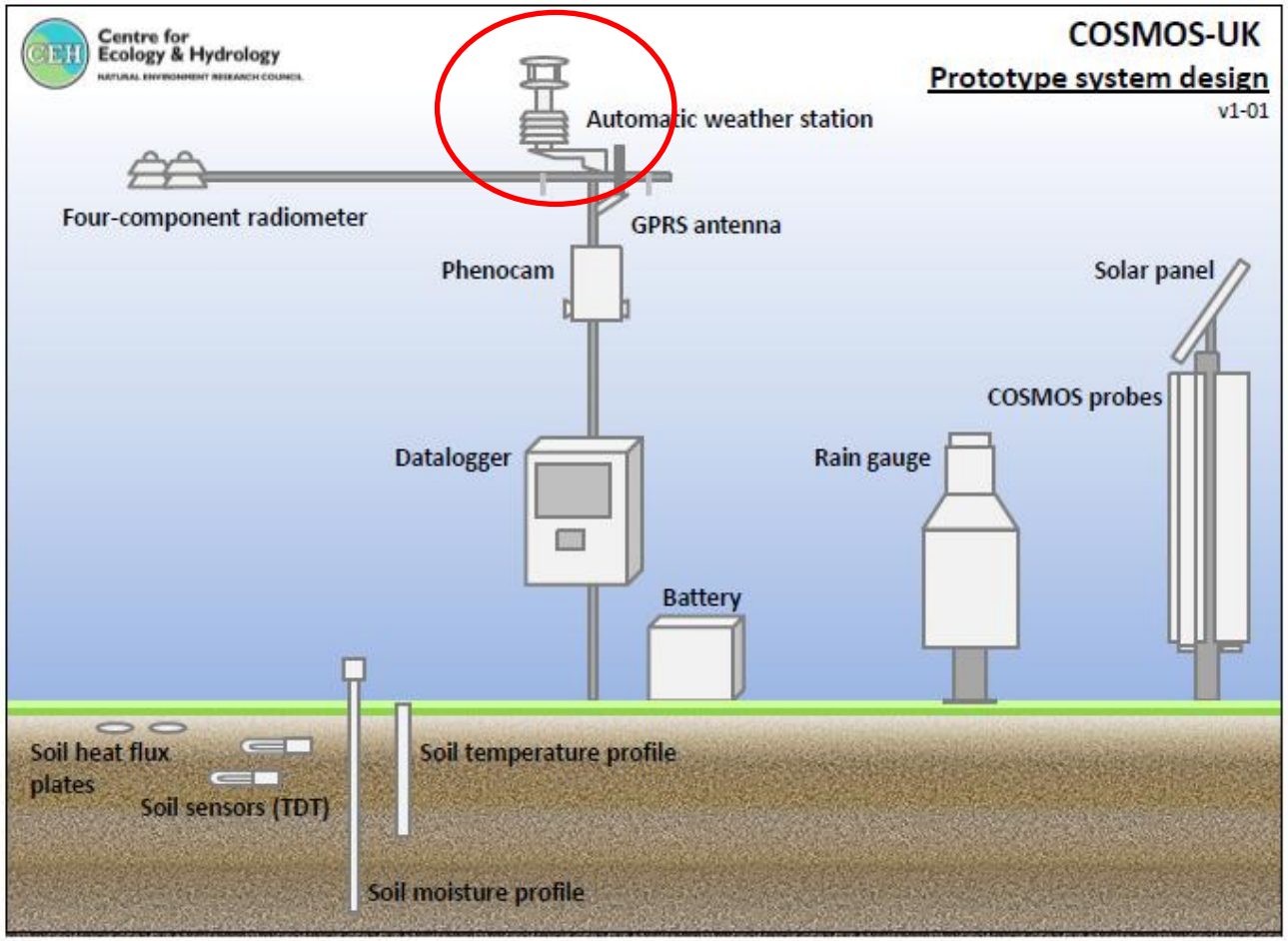
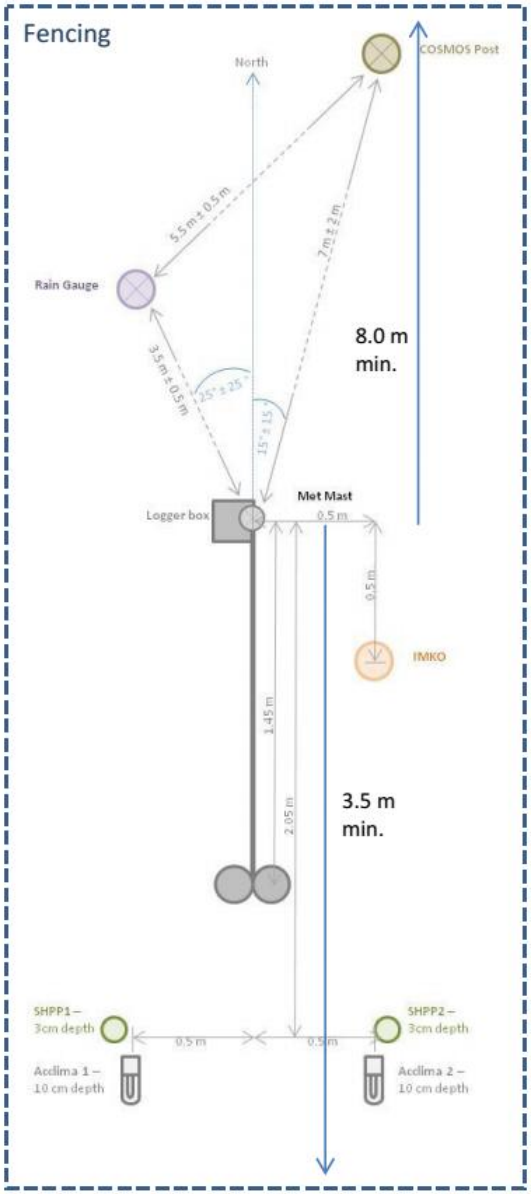
COSMOS-UK Phase 1 Prototype Stations





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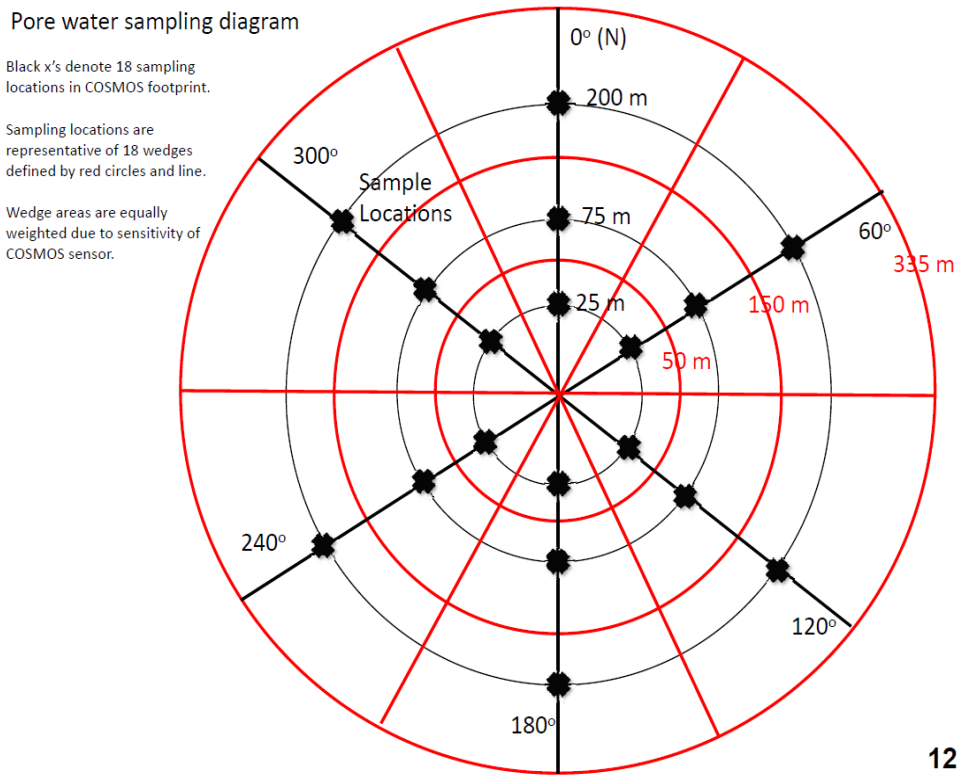
Calibration: Soil Sampling & analysis

- 108 soil samples from 18 locations at 6 depths
- Compaction issues
- Volumetric soil water and bulk density by oven drying
- Data streams updated
- Lattice and bound water (incinerated @ 1000˚C)
- SOM and SOC by loss-on-ignition
- Biological samples



Franz, 2012

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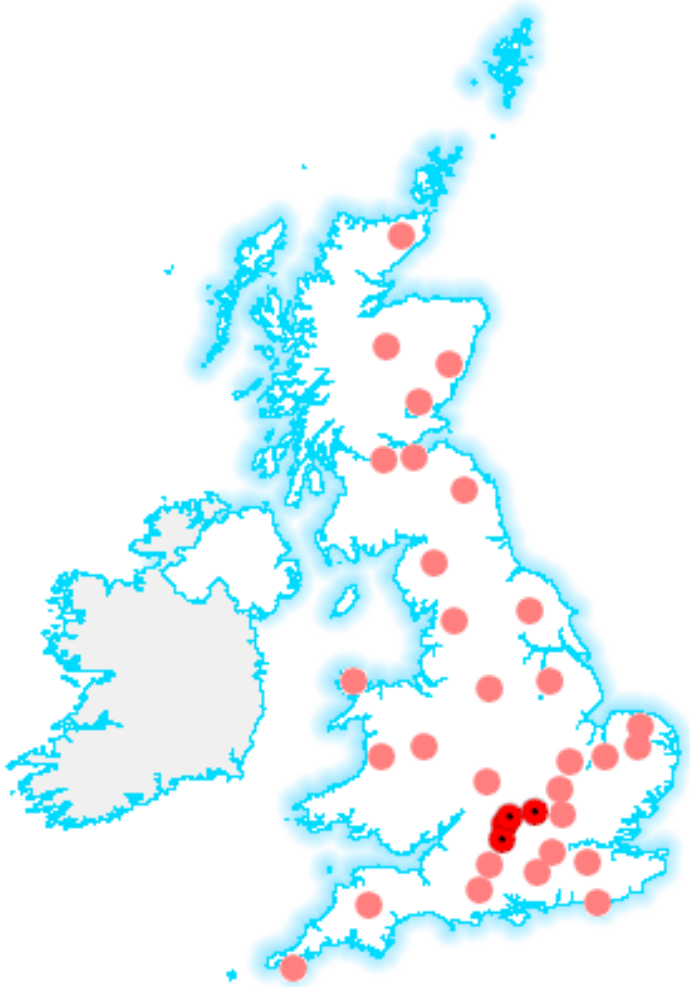
COSMOS-UK: Summary of Year 1

- First stage of COSMOS-UK network development
- Standard weather station and soil sensors
- Four prototype sites now running
- Automated data handling & web services developed by CEH Wallingford: http://www.ceh.ac.uk/cosmos/live-data.html
- Soil sample collection for gravimetric calibration
- Outreach to science applications and users

Phase 2: Site Selection

- Existing permissions
- Protected sites (e.g. SSSIs)
- Accessibility
- Security / vandalism risk
- Land cover boundaries
- Streams, rivers, water bodies, etc within 350 m, shallow/perched groundwater



http://www.ceh.ac.uk/cosmos/live-data.html

UK land cover example

Land Cover Class	%	COSMOS-UK sites *	
		Proportional	Targeted
Broadleaved, Mixed and Yew Woodland	6	2	3
Coniferous Woodland	5	3	2
Arable and Horticulture	26	11	6
Improved Grassland	25	11	14
Semi-natural Grassland	13	6	10
Mountain, Heath and Bog	16	7	5
Freshwater	1	0 (note 1)	0 (note 1)
Built-up and Gardens	6	0 (note 2)	0 (note 2)
Coastal	2	0 (note 1)	0 (note 1)

Source: Land Cover Map 2007
* assuming 40 in total
note 1 – proximity to water (hydrogen) probably excludes these sites
note 2 – urban excluded at this stage

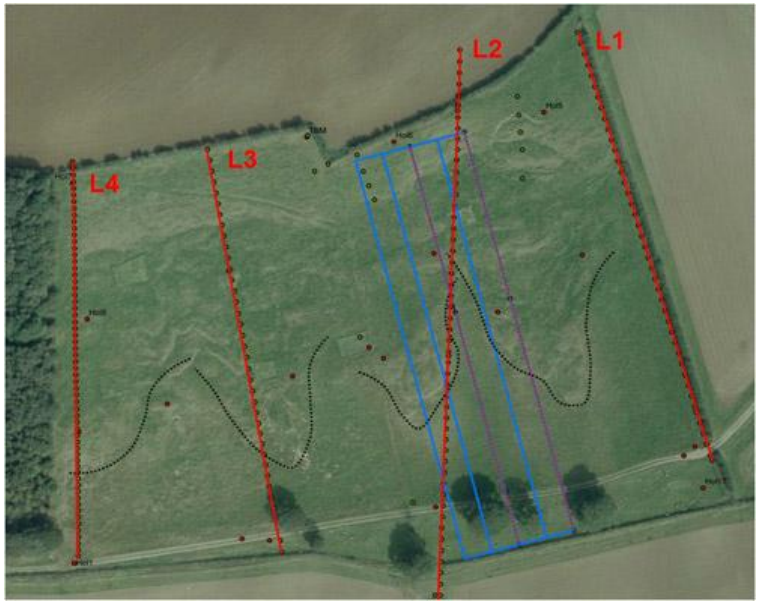
Phase 2: Site Visits

- Reasonably flat within a 350 m radius
- c. 70 cm soil depth
- Consistent land cover
- Avoid surface water
- Station orientated north-south in 12 x 3 m compound
- Suitable for meteorological instrumentation

Phase 2: Site Visits

- Calibration points within a 200 m radius are accessible and samples can be taken
- Possible to auger to 30 cm depth for calibration; 50 cm for rain gauge; 75 cm for IMKO sensor
- Sufficient GPRS coverage
- Vehicle access and away from public areas (i.e. reduce risk of vandalism, theft)
- Maintenance visits OK
- Avoid inconvenience for land owner/manager

Phase 2 Pilot Sites: Hollin Hill, York



http://www.bgs.ac.uk/science/landUseAndDevelopment/landslides/hollinHill.html

- BGS: detailed point and down slope soil moisture measurements
- Calibration issues?

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Phase 2 Pilot Sites: Morley, East Anglia

Phase 3 COSMOS-UK sites

- Increase the density of the network to provide greater spatial coverage
- Increase the monitoring of various land cover-soil-geology combinations
- Address particular science questions or projects (e.g. a subset of stations within a particular catchment; regional network(s) covering a particular land cover type).
- Some phase 3 sites could be built to a lower specification if objective is to increase network density – or visa versa
- COSMOS-UK test and validation site – 120 Acclima TDT sensors

Thank you.

Questions..?

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